RANDOLPH, TONYA

From: RANDOLPH, TONYA
Sent: Tuesday, April 21, 2015 8:28 AM
Subject: FW: Email response for W. Vermont St GW contamination (7300171)
Attachments: WVT St Wells.docx; Vt St 2014.pdf; Vt St 1972.pdf; Vt St 1962.pdf; Vt St 1956.pdf; Vt St 1941.pdf

From: FINLEY, SARAH
Sent: Monday, April 20, 2015 10:49 AM
To: JAWORSKI, MARK
Cc: Duncan, Dominique
Subject: Email response for W. Vermont St GW contamination (7300171)

Geologic and Hydrologic Updates
West Vermont St. Ground Water Contamination
Speedway-Indianapolis, Marion County
Site # 7300171 (GZ04R)

Mark,

Attached are some additions and clarifications to the geology, hydrology, and contaminant sources for the W. Vermont St report. My additions to the original geology section are highlighted in yellow. There is also some further background review (if you need it) from my analysis of the Michigan Plaza 2014 RWP. Finally, I included Juliet's discussion of the Riverside wellfield connectivity from the HRS package if the supporting documentation is needed.

Also attached are screen captures of the 2014, 1972, 1962, 1956, and 1941 aerial photos from indygov.org general map viewer.

Let me know if you have any questions.

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Geological Services
(317)234-0997

3.0 GROUND WATER MIGRATION PATHWAY

3.0.1 General Considerations

LOCAL GEOLOGY

Surficial soils near the residential wells and potential sources consist of Urban Land-Genesee complex along the north bank of Little Eagle Creek and in a small area near west Vermont St in the southwest corner of the area of interest. Genesee soil consists of very deep, well drained soils that formed in loamy alluvium on flood plains. Urban Land- Fox complex is present through the remainder of the area of interest and in most of the land between the two creeks. Fox complex soil consists of very deep, well drained soils which are moderately deep to stratified calcareous sandy outwash. These soils formed in thin loess and in loamy alluvium or just in loamy alluvium overlying stratified calcareous sandy outwash on outwash plains, stream terraces, valley trains, kames, and glacial moraines.

The sediments beneath the residential wells, potential source areas, and Speedway and Riverside wellfields are outwash with some till caps. Outwash is sediment deposited by meltwater usually composed of sand and (or) gravel (IGS). Till is unsorted sediment deposited directly from glacier ice with little or no reworking by meltwater or mass movement (IGS). Sediments in the Riverside wellfield consist of thick sections of sand and gravel interstratified with a few, small, widely scattered till units. Approximately 80-100 feet of unconsolidated sand and gravel are present on top of the bedrock in the area. The aquifer is unconfined and the recharge rate is high.

Boring logs in the project area show that unconsolidated sediments consist primarily of sand, with interbedded fine-grained units between 30 and 80 feet bgs. Some locations, notably wells MMW-P-20LA, MMW-P-21LA, MMW-P-22LA, MW-WES-01C, and MW-WES-6D show vinyl chloride contamination below the first encountered fine-grained sediments.

The thickness and extent of the finer grained material are insufficient to form a barrier to vertical contaminant migration. The finer grained unit from 35-50 ft bgs is not present in parts of the study area (see boring logs for MMW-4D, MMW-5D, MMW-6D, MMW-13D, MMW-14D, MW-165D, and MW-166D). There are no aquifer boundaries or discontinuities between the residential wells and the Riverside and Speedway wellfields. The aquifer is continuous in within a 2-mile radius as shown on the IGS Figures 31a and 32a.

Shale bedrock of the New Albany Formation is present between 70-80 feet bgs. The New Albany Formation is between 100-130 feet thick and poorly permeable. It is not a major ground water producing unit and is considered an aquitard.

Bedrock in the Riverside wellfield is Devonian-aged Muskatatuck group consisting of crystalline limestone and lesser calcareous shales. Prior to glaciation, the top of the bedrock surface was

exposed to weathering and underwent karst development. Within the wellfield, the outwash aquifer is directly on the bedrock, which is relict karst, therefore, the limestone aquifer is hydraulically connected to the outwash sand and gravel aquifer. The carbonate rocks lying…immediately beneath the outwash have undergone extensive solution-channel development. Possible solution cavities and/or voids were identified in the test piezometers cored near Riverside municipal well RS-29.

Subsurface materials beneath the site, the Speedway wellfield, and the Riverside wellfield are part of one continuous sand and gravel outwash plain that extends across the White River and lower Eagle Creek stream valleys.

HYDROGEOLOGY

The potential sources Genuine Parts (GP) and Michigan Plaza (MP) and the target receptor wells are situated within the stream valley for Little and Big Eagle Creeks. The confluence of these creeks is approximately 5700 feet south where they form Eagle Creek and, south of W. North Street, Little Eagle Creek is functionally within Big Eagle Creek stream valley and ground water from the east flows regionally toward Big Eagle Creek and the confluence rather than individually into each stream (refer to USGS topo map and October 2014 gauging data).

Ground water in the study area is encountered between 14 and 18 feet bgs in monitoring wells. Ground water is unconfined and hydraulically connected throughout the study area, based on pump tests in the Riverside wellfield and the lack of an aquifer discontinuity or boundary. Little Eagle Creek does not form a hydraulic boundary, as evidenced by contamination sourced north of the creek which underflows the stream. Based on the evidence above, ground water in shallow and deep sand and gravel horizons is part of the same aquifer.

The stream channel of Big Eagle Creek within the lower valley has been rerouted over time. Review of historic aerial photographs from 1972, 1962, 1956, and 1941 (available at http://maps.indy.gov/MapIndy/) shows that Big Eagle Creek steam channel south of Vermont St, was originally much closer to what is now the intersection of Holt Road and Cossell Ave. The original stream channel implies that natural flow can be to the southwest as well as southeast.

The ground water flow direction in the project area is generally towards the south with some components of flow to the southeast and southwest. Regional ground water flow near the Speedway wellfield is nearly parallel to Eagle Creek or northwest to southeast.

The contaminated residential wells are between 41 and 75 feet deep. These are similar depths to the contaminated monitoring wells associated with the Genuine Parts and Michigan Plaza releases.

In 2013, Mundell performed slug tests on seven wells near the residential wells. The hydraulic conductivity averaged 70.9 feet per day with a maximum of 141 feet per day.

Estimated aquifer transmissivity around the Speedway wells is between 70,000 and 100,000 GPD/ft. Estimated hydraulic conductivity in the Riverside wellfield is 100 ft/day.

The ground water system in the area of the Speedway wellfield consists of two aquifer layers, separated by a clay layer (aquitard) of varying thickness. Both aquifer layers in the valley sediments are hydraulically connected with adjacent sand and gravel layers in the glacial till beneath the uplands. The Speedway wellfield conceptual site model implies that the two aquifers are interconnected within the Eagle Creek valley. The ground water in the Riverside wellfield is also connected to the study area. The sandy outwash extends up the Eagle Creek valley to the Speedway wells and eastward in to the White River valley to the Riverside wells. The wells in both wellfields are screened at similar depths and in similar geologic material as contaminated wells in the project area. There are no aquifer boundaries such as faults or mountain ranges between the project area and the Speedway or Riverside wellfields.

For addition into the **Additional Facilities Investigated as Possible Sources** section

Genuine Parts (GP) and Michigan Plaza (MP) are the principle sources of contamination in the deeper parts of the sand and gravel aquifer where the target receptor wells are screened. Recent EPA sampling upgradient of GP showed only trace levels of contaminant in one location. Sampling along Holt Road and Michigan Street west of the intersection showed no detectable contamination. There are no other sources of contamination upgradient of the target receptors.

GP is directly north of Little Eagle Creek and shallow ground water contamination is contained on-site, but deeper ground water underflows the creek and enters the main valley associated with the confluence of Little and Big Eagle Creeks. This is supported both by ground water gauging and contaminant concentrations in wells MW-165S&D, MW-166S&D, MMW-3S, MMW-4D, MMW-5D, MMW-6D, MMW-7S, and MMW-18D&LA. The GP contamination flowing into the lower valley is only present in wells screened greater than 10 feet below the water table.

Ground water contamination related to the MP sewer release source areas is present from the top of the water table to the sands below the first encountered fine grained unit. As explained in section 3.0.1, there is no aquifer discontinuity between the water table and the top of the first fine grained unit.

The two contaminant plumes are co-mingled in the area south of the east-west sewer line north of Michigan Street (MP main source area). South of Little Eagle Creek and north of well nests MW-174 and MMW-11, there is no detectable contamination at the water table. Co-mingling begins where shallow contamination is present in wells MMW-8S, MMW-9S, MMW-10S, and MMW-12S. As explained in section 3.0.1, shallow and deep horizons are interconnected and part of one aquifer.

<u>These paragraphs are pulled directly out of my last review of the Michigan Plaza 12-31-14 RWP. Use if you think you need them</u>

Based on the available contaminant and aquifer data from the 2014 RWP, the Michigan Plaza release is a contributing source of contamination in the 'lower aquifer'. The current on-site shallow contaminant profile is not representative of pre-remedial steady state conditions. The highest levels in the 'lower aquifer' are directly beneath the Michigan Plaza source areas. The deep horizon was not monitored in the sources until recently. The behavior of the shallow contamination after the remedial injections (increases of >1000% of VC) shows that the original PCE contaminant mass was greater than anticipated. PCE at high concentrations sinks through the water column. Ten feet of fine grained material is an insufficient barrier to inhibit vertical migration of a solvent.

<u>Section 2.4.4.2:</u> This section of the 2014 MP RWP states that PCE and TCE have never been detected in the deep upper sand in the Michigan Plaza source areas. That statement is inaccurate. 2007 grab samples collected from 30 and 40 ft-bgs from exploratory borings MMW-8S, MMW-P-07 and MMW-P-08 contained PCE (see table 2.2.0.6). These were completed as shallow wells. After the initial results, no samples were collected from the deeper parts of the aquifer in the source areas until after the 2007, 2009, and 2013 CAP18 injections.

The lack of PCE in recent samples from the base of the 'deep upper aquifer' and in the 'lower aquifer' is insufficient evidence that Genuine Parts is the only source of contamination in these intervals. As previously discussed there is not a sufficient barrier to vertical PCE migration. The geochemical conditions allow chlorinated solvent contamination to degrade to DCE and VC quickly. Finally, Michigan Plaza performed three bioremediation injection events in 2007, 2009 and 2013, which converted PCE into DCE and VC. The deep wells to monitor the effects were installed in 2014.

This is supporting information pulled from Juliet's geological assessment of the Riverside wellfield.

The results of the Fall Creek/White River Tunnel System, Piezometer Monitoring Summary report, dated April 2013 and prepared by Black & Veatch (Ref. 012, pp. 1-13) further demonstrate the connectivity of the aquifers. A series of piezometers were installed as part of a geotechnical investigation that included the WHPA (Ref. 008). Piezometers GW-04-DC/SC and GW-05-DC/SC installed near RS-29 Ref. 008terminate between 113 and 220 feet bgs (Refs. 008 and 010). Well construction logs for all the piezometers show they vary in depth from about 48 to 269 feet bgs (Ref. 009, pp. 1-106) so they measure both the outwash and carbonate aquifers. The results of the piezometer monitoring show connectivity between the surface water, outwash aquifer, and carbonate aquifer (Ref. 012, pp. 2-5):

> "A correlation is evident between deep groundwater levels, precipitation, and stream level. In general, the water levels measured fluctuate in a similar pattern

> to both precipitation and stream level indicating hydraulic interconnectivity with the White River, Fall Creek, and the carbonate aquifer." (Ref. 012, pp 3).

Based on these results, the aquifers beneath the site can be considered a single, connected aquifer for HRS scoring purposes.

Ref. 008: Geotechnical Investigation Boring Location Plan – Fall Creek / White River Tunnel System, prepared for Citizens Energy Group by Black & Veatch, Figure 1-1, dated December 2013. 1 page

Ref. 012: Citizens Energy Group – Fall Creek/White River Tunnel System – Piezometer Monitoring Summary – Winter 2013, prepared by Black & Veatch, April 2013. 13 pages

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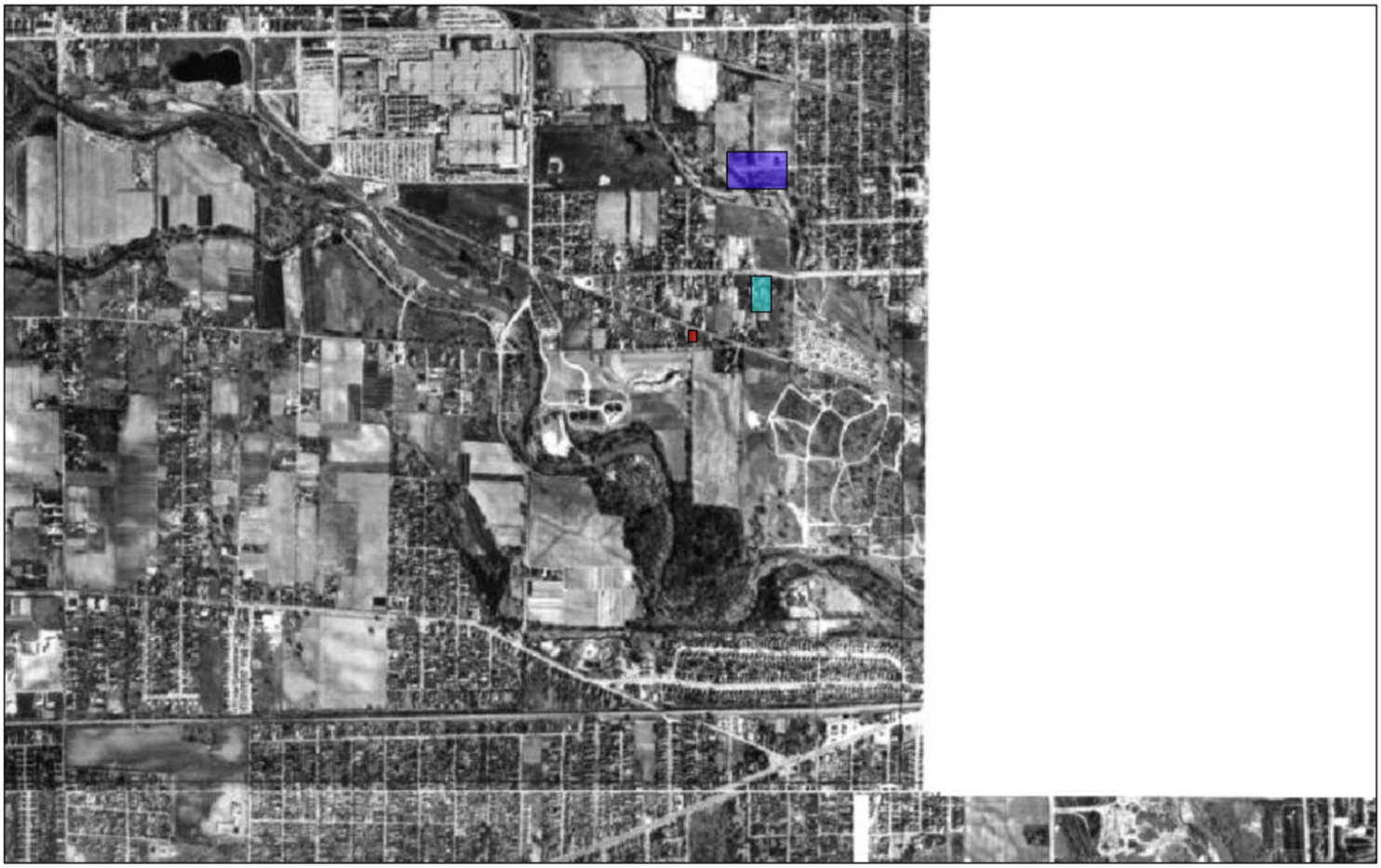

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